Money Demand and Inflation in a Highly Dollarized Economy: Fighting Inflation in Cambodia

Chanthol, Hay

National University of Battambang

1 March 2021

Money Demand and Inflation in a Highly Dollarized Economy: Fighting Inflation in Cambodia

Hay Chanthol*
Graduate School of Public Policy, the University of Tokyo

March 01, 2021

Abstract

Money supply in a highly dollarized Cambodian economy appears to be highly unstable because the composition of domestic currency in aggregate money supply is very small. During its transition towards a market economy, Cambodia embarked upon a path of disinflation through dollarization and stable exchange rate. In this paper, the trend and behavior of money supply, money demand and inflation are examined, and a model is developed to explain the determinants of inflation under dollarization and estimate it for Cambodia in the 2000s using a two-step procedure. This paper also shows that management of rice price, gasoline price with a restrictive monetary policy based on broadly defined money or total liquidity was essential for the Cambodian authorities to succeed in fighting inflation. This paper explain the behavior of inflation and the role that a central bank may play in its determination.

1 Introduction

Cambodian economy is nowadays the highest dollarized economy in the region. Not many small countries in the world become highly dollarized like Cambodia. The high degree of dollarization is evidenced by the sharp increase in dollar deposit in financial institutions such as microfinance institutions and banks, which are almost privately owned. The recent increasing dollarization after 2000 was driven by international capital inflow and increasing foreign trade and confidence in the economy. The U.S. dollar (USD) has spread to households through loans from financial institutions and salary they received from working in private sectors such as garment sector and tourism sector. The National Bank of Cambodia issued Cambodian currency, the Khmer riel (KHR), at a slower rate than foreign currency. The Cambodian riel was mainly used by public sector to pay for civil servants' salaries. Therefore the riel is still used in all areas of Cambodia where there are civil servant workers. Private firms also borrow money denominated in U.S. dollar. Recent survey result issued by Credit Bureau of Cambodia (CBC) indicated that about 95% of total loan in Cambodia was denominated in U.S. dollar.

When we look at the history of currency after the Pol Pot regime in which money was not used and which was overthrown in January 1979, people first started use commodity money

*My email: hchanthol99@yahoo.com

such as gold and rice. At the beginning of the new regime in 1979, domestic production of foods was not enough because production was disrupted by war; people used gold for trading with Vietnam or Thailand for foods and other necessities. For domestic exchange, people used rice or fish for buying goods and services. Some students who go to private school use d rice to pay for tuition fees in the early 1980s. People started to use riel and gold as stores of value. But gold became less popular when the quantity of U.S. dollars increased in the country and became widely used. However, because of experience of large currency depreciation , people reluctant to hold deposit denominated in KHR. But people use U.S. dollar for saving instead.

The total liquidity, which is called aggregate money, includes money plus quasi-money. Money consists of currency outside banks and demand deposit. Quasi-money consists of time and saving deposit and foreign currency deposit. Cambodian economy's total liquidity is characterized by a dominant share of foreign currency deposit and relatively small shares of demand and time deposits because Cambodia is a highly dollarized economy. The fluctuation in total liquidity is dominated by the fluctuation of foreign currency deposit. The largest share of total liquidity was foreign currency deposit. The quantity of foreign currency deposit started to surpass the quantity of currency outside banks in 1994, just one year after the first general election. Because foreign currency deposit is the dominant component of total liquidity, the fluctuation of total liquidity was moving in the same direction as the fluctuation in the foreign currency deposit, in particular since 2002. Because foreign currency was not issued and supplied by domestic monetary authorities, controlling inflation through controlling money in the economy was likely to be difficult.

This paper investigates the relationship between money and inflation in Cambodia to find out what should be effective measure to control inflation by combing two main theories, namely, the markup theory of inflation and the monetary theory of inflation. Because aggregate money is composed of local currency and foreign currency, an analysis of the monetary theory based on different components of money was completed, to see if there are any different impacts of money on inflation.

Section 2 provides historical behavior of monetary aggregate in Cambodia. Section 3 reviews monetary policies of the National Bank of Cambodia. Section 4 combines the mark-up theory and monetary theory of inflation to analyze determinants of inflation in Cambodia. Some conclusions are in section 5.

2 Historical behavior of monetary aggregates

Some perspective on the behavior of monetary aggregates in Cambodia is provided by Figure 1, which plot annual end of year in December composition of aggregate money from monetary survey of National Bank of Cambodia. The total liquidity, which is called aggregate money, includes money plus quasi-money. Money consists of currency outside banks and demand deposit. Quasi-money consists of time and saving deposit and foreign currency deposit. Cambodian economy's total liquidity is characterized by a dominant share of foreign currency deposit and relatively small shares of demand and time deposits because Cambodia is a highly dollarized economy.

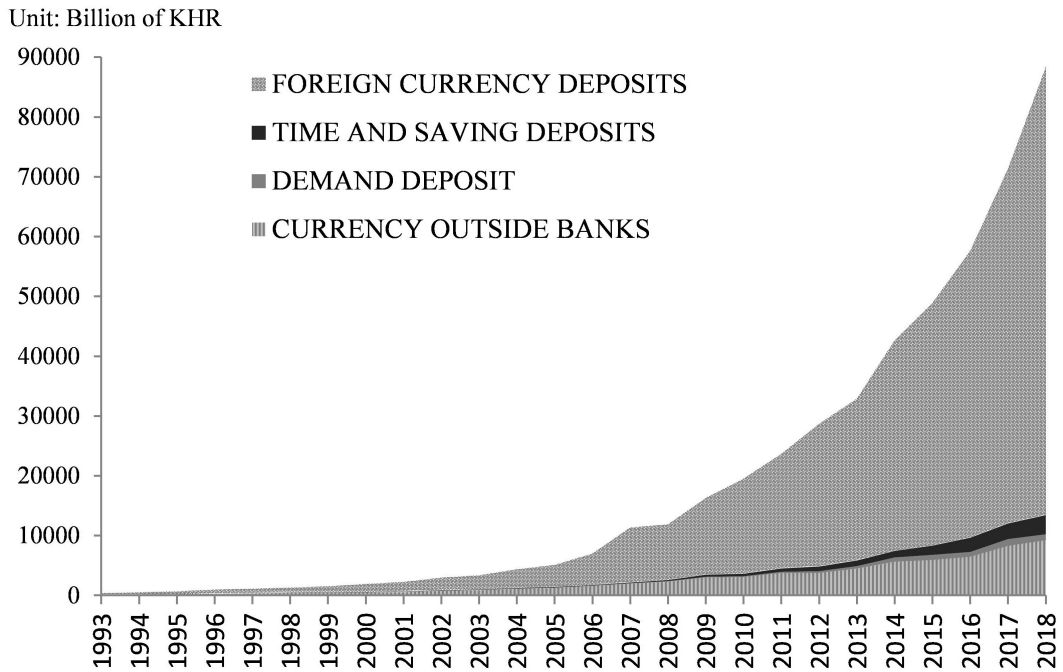

Figure 1: Composition of money supply.

The fluctuation in total liquidity is dominated by the fluctuation of foreign currency deposit. Total liquidity increased from 333.46 billion riels in 1993 to 88443.2 billion riels in 2018. The largest share of total liquidity was foreign currency deposit, which increased from 36.32% of total liquidity in 1993 to 84.8% in 2018. This large share of foreign currency deposit in total liquidity makes Cambodia the highest dollarized country in the region and among the highest dollarized country in the World. Currency outside banks is the second largest component of total liquidity. However, in contrast to the dominant share of foreign currency deposit in total liquidity, the share of currency outside banks in total liquidity has continued to decline over time. The share of currency in total liquidity declined from 56.8% in 1993 to 10.46% in 2018. The quantity of foreign currency deposit started to surpass the quantity of currency outside banks in 1994, just one year after the first general election. Because foreign currency deposit is the dominant component of total liquidity, the fluctuation of total liquidity is moving in the same direction as the fluctuation in the foreign currency deposit, in particular since 2002. The other two components of total liquidity, demand deposit plus time and saving deposit, show minimal share in total liquidity. Demand deposit share in total liquidity was 4.2% in 1993 and 1% in 2018. Similarly, time and saving deposit share in total liquidity was 2.5% in 1993 and 3.6% in 2018.

Each component of money supply increased but at different speed. The local currency components grew at a lower speed than foreign currency deposit. Although, time and saving deposit, which is also local currency, grew at higher speed than foreign currency deposit, time and saving deposit represented a small share of total liquidity. The average annual growth rate of total liquidity over 1994-2018 period was 25.17%, currency 18.55%, demand deposit 20.30%, time and saving deposit 30.14% and foreign currency deposit 28.3%. Total liquidity growth fluctuated around 20%, except in 2007 and 2008 as shown in Figure 2. Total liquidity growth rate jumped to 62.92% in 2007, but decreased to 4.84% in 2008. Similarly, foreign currency deposit growth rate decreased from 75.86% in 2007 to 1.49% in 2008. This decrease in liquidity growth rate can be attributable to the political uncertainty in the 2008 National Assembly election, the effects of global financial crisis and the increase in reserve requirement

ratio imposed on foreign currency deposit.

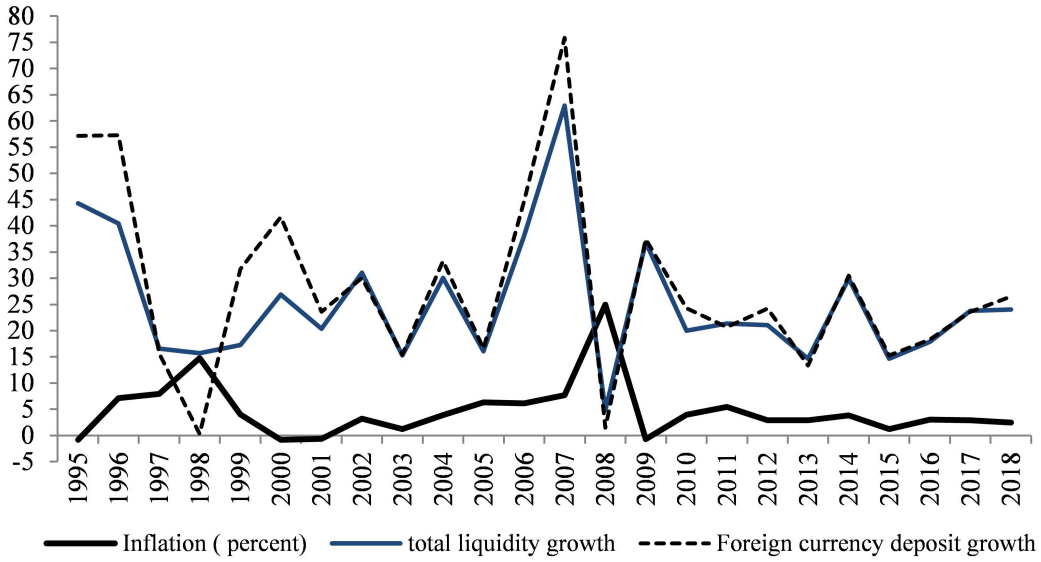

Figure 2: Money growth and inflation.

During the period of high credit growth and surging inflation, on June 2008 the NBC increases the reserve requirement rate for foreign currency from 8% to 16% to restrict the liquidity in the economy. Because foreign currency deposit is the dominant component of total liquidity, the fluctuation of total liquidity followed the fluctuation of foreign currency deposit, especially during the period of stable exchange rate after 2001. Since 2001, the exchange rate of the Khmer riel against the U.S. dollar has been stable, moving in the band of 3,900 riels per U.S. dollar and 4,100 riels per U.S. dollar, except in 2009 and in 2010 when the Khmer riel depreciated to 4,139 riels per U.S. dollar and 4,184 riels per U.S. dollar, respectively. Because Cambodia is a highly dollarized economy in the region, the 2008 global financial crisis did not cause large depreciation of Cambodian riel against the U.S. dollar.

Money growth seems to cause inflation with one or two year lag as shown in Figure 2. High rates of money growth in 1995 and 1996 seem to cause high inflation in 1997 and in 1998. Similarly, high inflation in 2008 is also explained to some extent by large increase in money supply in 2007. In 1998 which is the year after Asian financial crisis and the factional fighting that happened near the capital of Phnom Penh saw an increase in narrow money, local component of money, of 41% while the foreign currency deposit increased by 0.3%. As a result of the large increase in local currency, exchange rate sharply depreciated and inflation jumped. Exchange rate depreciated by 27% and inflation soared to 15% in 1998.

3 Monetary policy , exchange rate and inflation

The National Bank of Cambodia (NBC) has not use open market operation to control money supply yet. However, three monetary policy tools have been used by NBC. Conventional monetary policy tools applied by many advanced economies to affect money supply include discount rate, reserve requirement and open market operation. Those three tools for NBC indicates that Cambodian monetary authority have limited role in controlling money supply. Those 3 tools are reserve requirement, negotiate certificate of deposit (NCDs) and liquidity-providing collateralized operation (LPCO).

First, reserve requirement is a monetary policy tool which contributes to maintain price stability; it is also a macro-prudential tool for protecting depositors. The National bank of Cambodia (NBC) sets the reserve requirement rate, requiring all regulated banking and financial institutions to keep a proportion of their customers' deposits and external borrowings at the NBC to guarantee a safe level of liquidity and also to protect the banking system against potential liquidity shocks. Because Cambodian economy is highly dollarized, the NBC sets reserve requirement for both Khmer riel and U.S. dollar. To promote the use of Khmer riel, the reserve requirement rate for Khmer riel has been set lower than the reserve requirement rate for foreign currency. Currently, the reserve requirement rate for Khmer riel was set at 8% and 12.5% for foreign currency. During the period of high credit growth and surging inflation, on June 2008 the NBC increases the reserve requirement rate to for foreign currency from 8% to 16% to restrict the liquidity in the economy. This rate was reduced to 12% in January 2009 when inflation moderated, and the economy was hit by global financial crisis. Since September 2012, the NBC has increased this rate to 12.5% and after that reserve requirement for non-resident borrowing has also been reset to 12.5% too to strengthen the banking system. Meanwhile, reserve requirement rate for the Khmer riel has been maintained at 8% since 1997.

Second, negotiable certificate of deposits (NCDs) acts like a kind of security issued by NBC. It is a more effective liquidity management tool for banks and microfinance institutions and development of interbank market. NCDs are both Riel-denominated and USD-denominated. NCDs has different maturity stages: seven days, 14 days, 28 days, 91 days, 192 days, and 364 days. The demand for NCDs increased to around 20.8 billion USD for USD-denominated NCDs in 2017. KHR-denominated NCDs was about 15.5 trillion USD in 2017. The demand for NCDs remains robust as banks and MFIs persistently keep excess reserves while credit to private sector continues to decrease. Based on the market situation, the interest rates charged on USD-denominated and riel-denominated NCDs with short-term maturity were reduced to develop the inter-bank market and to lower the lending interest rates charged by banks and MFIs.

Third, liquidity-providing collateralized operation (LPCO): NBC conducts the LPCO in riel, whilst requiring NCDs to be collateralized to provide banking and financial institutions with cheap liquidity and to increase lending in local currency. In 2017, the LPCO operation, conducted monthly, provided liquidity totaling 165 billion riels with an average interest rate of 3%. To help banks and MFIs get longer term liquidity in riel, the NBC change the maturity from 91 days to 364 days in mid-1997. Though participation at the LPCO auction is still limited, 4 microfinance institutions participated in the bidding process.

The exchange rate was relatively stable against the U.S. dollar, in particular, since 2001. However, during the period of economic liberalization in 1990s, the Khmer riel depreciated sharply against U.S. dollar in the period before and after the first general election held in 1993 as shown in Figure 3. In 1990, a U.S. dollar was traded for 426.25 Khmer riels. The Khmer riel depreciated sharply to 718.33 riels per U.S. dollar in 1991. Asian financial crisis which was happened in 1997 also caused the Khmer riel to depreciate further. The Khmer riel depreciated from 2946.25 per U.S. dollar to 3744.42 per U.S. dollar. However, the exchange rate has become stable since 2001, which fluctuated around 4000 riels per U.S. dollar since 2001.

Cambodia adopted a managed floating exchange rate regime in 1992 based on the U.S. dollar. The National Bank of Cambodia (NBC) intervenes in the foreign exchange market to smooth the foreign exchange movements through foreign exchange auctions, and to defend against speculative attack as market sentiments and psychological factors caused disorder in the foreign exchange market. The current exchange rate regime is based on keeping the Khmer riel broadly stable against the U.S. dollar and is appropriate for Cambodia given high dollarization

and a concentration in U.S. dollar-invoiced exports (IMF's Article IV 2018).

Foreign exchange market intervention has been frequently implemented to keep the KHR against USD exchange rate volatile within +/-1% of the official exchange rate. In 2013, NBC purchased 316.45 million U.S. dollars with 1,268 billion riels. NBC sold 73 million U.S dollars to Ministry of Economy and Finance and bought 27.15 million U.S dollars from Ministry of Economy and Finance in respond to the increasing demand of local currency and the increasing capital flows (NBC annual report 2013). Consequently, the net purchase of U.S. dollars has been positive, especially since 2006.

To stabilize the exchange rate, Cambodia's monetary authority need enough international reserve currency. Gross international reserve has increased over time since 1993. International reserve increased from 71 million USD in 1993 to 9,605 million USD in 2018. During the Asian financial crisis, the international reserve accounted for about 5.5 months of prospective imports of goods and services in 1997 and 3.6 months in 1998. But this high rate of international reserve was not used as cushion against currency depreciation in those years. According to the threshold set by International Monetary Fund, this level of gross international reserve is adequate because it is more than 3.5 months of import value given the country is not highly dollarized. However, because the central bank of Cambodia lose the role of a lender of last resort, the adequacy of reserve should also take into account foreign currency deposit. According to IMF article IV 2018, the gross international reserve could cover about 60% of foreign currency deposit. Thus more accumulation of international reserve is necessary to safeguard the economy from financial sector vulnerability and capital flow reversals.

Inflation was kept to single digits, except briefly in 1998 in the wake of the Asian financial crisis and in 2008 global financial crisis. The long-run average annual inflation over 1995-2018 period was 4.7%. The inflationary pressures in 2008 mainly were arising from the food and energy crises. The annual inflation, which is the percentage change in average annual consumer price index for all items, actually peaked at 25% in 2008, higher than inflation rate in 1998, which was recorded at 14.81% as shown in Figure 6. Unlike inflation in 2008, high rate of inflations in 1997 and 1998 were mainly driven by large currency depreciation. Cambodian riel depreciated 12% in 1997 and 27% in 1998 against U.S. dollar. Prior to 2001, inflation had strong relationship with exchange rate depreciation. However, the relationship became less important when the exchange rate became stable after 2001.

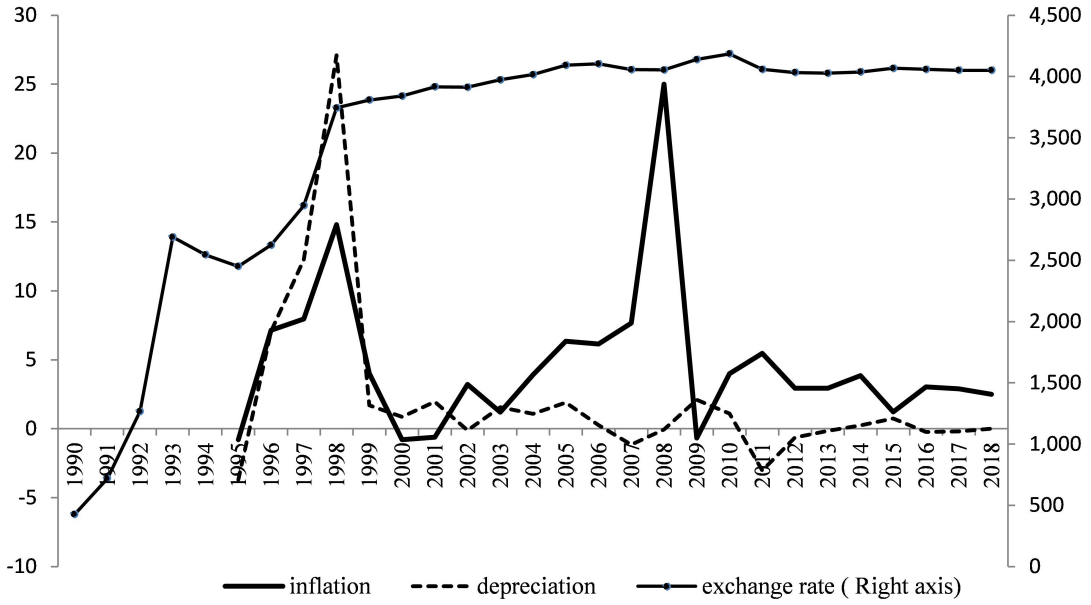

Figure 3: Exchange rate and inflation.

4 Markup theory and monetary theory of inflation

The degree of dollarization in Cambodia is very high. Most of the trasactions are conducted in U.S.dollar rather than domestic currency. When demand for U.S. dollars grows beyond the requirements of tourism and international trade, it is difficult for the monetary authority to find an appropriate definition of money and to control domestic liquidity. The component of money supply in Cambodian economy is dominated by foreign currency. Therefore, controlling money supply becomes difficult for monetary authority. We model the determinant of inflation in Cambodia by combing two main theories, namely, the markup theory of inflation and the monetary theory of inflation. The markup theory has a long standing and continuing presence in economics generally. The markup theory is attributable to Duesenberry (1950), Franz and Gordon (1993), while the monetary theory of inflation is typically associated with Friedman and Schwartz (1963). The markup theory is often used as a framework for estimating the long-run determinants of inflation, while the monetary theory is mostly used to model short-run inflation dynamics.

According the markup theory of inflation, in the long run, the domestic general price level is a markup over total unit costs, including unit labor costs, import prices, and energy prices. Assuming linear homogeneity, following De Brouwer and Erisson (1998) the long-run relation of the domestic consumer price level to its determinants is

$$P = \mu ULC^{\alpha} P_{im}^{\beta} P_{ut}^{\gamma} \tag{1}$$

Because rice is the main staple in Cambodia, the change in rice price will affect prices of other goods and services. The mark-up equation (1) was augmented by adding rice price. The augmented mark-up price level is rewritten as follow:

$$P = \mu ULC^{\alpha} P_{im}^{\beta} P_{ut}^{\gamma} P_{rice}^{\theta} \tag{2}$$

where P is CPI, μ is the markup, ULC is unit labor cost, i.e., the average wage cost per unit of output, P_{im} measures the price of imported inputs, and P_{ut} is an index of utility prices, including energy and electricity. The elasticity of the CPI with respect to each input price are denoted by α, β, and γ, respectively; they are hypothesized to be positive and constant. Moreover, P is typically assumed to be linearly homogenous so that raising the cost of each input by x percent leads to an increase in consumer prices of x percent.

Taking log on both sides of this equation (2) , we have

$$log(P) = log(\mu) + \alpha log(UCL) + \beta log(P_{im}) + \gamma log(Put) + \theta log(P_{rice}) \tag{3}$$

According to the monetary theory of inflation, inflation is driven by excess money supply. Inflationary pressures are expected to occur only when money supply exceeds money demand. According to this theory, high money supply growth cannot lead to high inflation if the high money supply growth is absorbed by high money demand growth. The demand for each component of the total liquidity is examined to see which component has strong effect on inflation. As it is argued in the previous section, when foreign currency is allowed to be used in domestic economy, the demand for money in general depends on income, foreign interest rate, domestic interest rate and currency depreciation. Following Bordo and Choudhri (1982), the demand for domestic money and foreign money are shown below:

$$logM_d – logP = \beta_0 + \beta_1 logY + \beta_2 i_d + \beta_3 i_f + \varepsilon_d \tag{4}$$

$$log(eM_f) – logP = \gamma_0 + \gamma_1 logY + \gamma_2 i_d + \gamma_3 i_f + \varepsilon_f \tag{5}$$

where M_d is domestic money, Y real GDP, i_d domestic interest rate, i_f foreign interest rate, ε error term . However, under conditions of perfect interest rate arbitrage, $i_d = i_f + \hat{E}$ where $\hat{E}$ is depreciation rate of domestic currency. Then the demand for domestic money in equation (4) can be rewritten as:

$$logM_d – logP = \beta_0 + \beta_1 logY + (\beta_2 + \beta_3) i_d - \beta_3 \hat{E} + \varepsilon_d \tag{6}$$

Both the mark-up theory of inflation and the demand for money showed the relationship in the long run. The determinants of the short-run inflation, similar to Oomesand Ohnsorge 2005, are estimated by the following equation:

$$\begin{aligned} \Delta log(P_t) = a_0 + \sum_{j=1}^{n} a_j \Delta log(P_{t-j}) + \sum_{j=1}^{n} \alpha_j \Delta log(UCL_{t-j}) + \sum_{j=1}^{n} \gamma_j \Delta log(Put_{t-j}) \\ + \sum_{j=1}^{n} d_j \Delta log(M_{t-j}) + bEC_1 + cEC_2 + \varepsilon_t \end{aligned} \tag{7}$$

where b tell us how much of the adjustment to equilibrium takes place, c shows how the excess supply of money translate into inflation acceleration and d tells how change in money supply affect inflation.

4.1 Data

Because monthly data does not cover long period of time, the data in this paper divided into two groups-annual data from 1994 to 2018 and monthly data from 2006M12 to 2017M12. Annual data is used for analysing quantity theory of m oney and Phillips curve. Monthly data is used

for analysing determinants of inflation in the short run.

Because we don't have long term montly data, the data for analyzing this inflation in the short run is monthly data from 2006 M12 to 2017 M12. Monetary survey data, interest rate data are collected from National Bank of Cambodia, CPI all items is from National Institute of Statistic. Interest rate for deposit denominated in Khmer riel and in U.S. dollar are 12-month interest rates. Utility price is proxied by gasoline price, which is an item in consumer prices (CPI) and it is also collected from National Institute of Statistics. Electricity price was not used to be a proxy for utility price because utility price kept constant for most of the period as it is regulated by authority. Electricity was not good enough for enterprises as outage occurred often. The minimum wage in the garment sector was used as a proxy for unit labor cost. Garment sector is the largest industry sector in the country employing about 700,000 workers. Garment sector has strong labor unions working to support workers to improve wage, working conditions as well as skills of workers. Therefore the wage in the garment sector is the most representative. Price of imported goods is proxied by exchange rate.

4.2 Results

Table 1 below shows the unit root rest for each variable in the model. Log level of most variable follow unit root but the change in log level of each variable is stationary. Therefore, we use change in log level of each variable to run inflation regression.

Table 1: Unit root test.

Unit root tests for regression variables 2006M12-2017M12			
	Augmented Dickey-Fuller test statistic		
variable	t-Statistic	Probability	lag length (AIC)
log(CPI_all)	-2.732 *	0.072	9
log(gasoline)	-2.423	0.137	1
log(ex_rate)	-2.383	0.149	12
log(min_wage)	-0.305	0.920	1
log(currency)-log(CPI_all)	0.701	0.992	12
log(M_1)-log(CPI_all)	0.718	0.992	12
log(liquidity)-log(CPI_all)	-0.400	0.905	1
log(FCD)-log(CPI_all)	-0.663	0.851	0
12-month KHR deposit rate	-1.939	0.314	0
12-month usd deposit rate	-2.255	0.189	3
1-year Tbill	-3.537 ***	0.009	3
Δlog(CPI_all)	-3.658 ***	0.006	0
Δdlog(gasoline)	-6.545 ***	0.000	0
Δlog(ex_rate)	-2.674 *	0.082	11
Δlog(min_wage)	-2.068	0.258	0
Δlog(currency)-Δlog(CPI_all)	-3.095 **	0.030	11
Δlog(M_1)-Δlog(CPI_all)	-2.822 *	0.058	11
Δlog(liquidity)-Δlog(CPI_all)	-8.810 ***	0.000	0
Δlog(FCD)-Δlog(CPI_all)	-4.701 ***	0.000	12
Δ12-month KHR deposit rate	-13.534 ***	0.000	0
Δ12-month usd deposit rate	-3.440 **	0.011	2
Δ1-year Tbill	-2.448	0.131	12

The result of the mark-up model is shown in Table 2. Minimum wage, gasoline price and rice price have significant positive effects on price level. The coefficients in column 2 of Table 2 measure the elasticity of CPI with respects to minimum wage, exchange rate, gasoline price and rice price. When rice price increases by 1%, for example, inflation increases by 0.36%. When minimum wage, exchange rate, gasoline price and rice price each increases by 1% , consumer price index is expected to be increased by 0.8% (ie. 0.196 + 0.126 + 0.115 + 0.368). We use this relationship as an error correction term, called EC1, for estimating short run inflation. We expect that when price deviates from its long-run path, there will be a pressure to push it down and price will move to its long-run path. So the coefficient for EC1 is expected to be negative.

Table 2: Inflation and markup.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.439	1.079	-2.261	0.026
LOG(MIN_WAGE)	0.196	0.007	29.622	0.000
LOG(EX_RATE)	0.126	0.123	1.028	0.306
LOG(GASOLINE)	0.115	0.011	10.210	0.000
LOG(RICE)	0.368	0.012	31.822	0.000
R-squared	0.983	Mean dependent var		4.970
Adjusted R-squared	0.982	S.D. dependent var		0.137
S.E. of regression	0.018	Akaike info criterion		-5.134
Sum squared resid	0.043	Schwarz criterion		-5.025
Log likelihood	346.400	Hannan-Quinn criter.		-5.090
F-statistic	1829.564	Durbin-Watson stat		0.359
Prob(F-statistic)	0.000			
Included observations: 133				

The current money supply in the sample period from 2006 to 2017, money supply is dominated by foreign currency deposit. Money supply consists of four components including currency, demand deposit, times and saving deposit and foreign currency deposit. The previous three components: currency, demand deposit, times and saving deposit are local currency. The total liquidity (or broad money), which is called aggregate money, includes money plus quasi-money. Money (or narrow money) consists of currency outside banks and demand deposit. Because of this dominant foreign currency in aggregate money, we estimate demand for money for currency, narrow money, broad money and foreign currency deposit. The residual from each of this regression is excess money supply and we use it as error correction, called EC2, to estimate short run inflation. The coefficient of this error correction term is expected to be positive because excess money causes inflation because too much money chasing too few goods.

Table 3 shows the results of the demand for each type of money, which is the real balance. The sigs of the coefficients of independent variables are consistent with economic theories and statistically significant. As shown in row 2 of Table 3, the GDP elasticity of currency demand is 1.54. The demand for currency is negatively related with 12-month deposit rate and also negatively related with currency depreciation (note: increasing in the value of exchange rate means depreciation). Similar result is obtained when we use narrow money as money. However, the coefficient for the depreciation of exchange rate $(DLOG(EXRATE))$, although consistent

with the theory, is not significant when we use currency or narrow money as the dependent variable. The coefficients for exchange rate depreciation become negative and significant when we use broad money, which is total liquidity of aggregate money, or foreign currency deposit as money in the dependent variable.

Table 3: Estimation of money demand.

Dependent variable : *LOG(M)-LOG(P)*					
Money (M)		C	LOG(GDP)	KH12MDEP	DLOG(EX_RATE)
currency in circulation	Coefficient	-2.059 ***	1.547 ***	-0.021 *	-0.544
	Std. Error	0.267	0.029	0.011	0.789
narrow money	Coefficient	-3.229 ***	1.703 ***	-0.021 *	-0.451
	Std. Error	0.270	0.029	0.011	0.797
broad money	Coefficient	-6.767 ***	2.405 ***	-0.057 ***	-1.855 *
	Std. Error	0.325	0.035	0.013	0.960
foreign currency deposit	Coefficient	-7.691 ***	2.501 ***	-0.064 ***	-2.047 *
	Std. Error	0.360	0.039	0.014	1.062

Because most of the variables in money demand equation follow unit roots, using the error correction to estimate short-run inflation is meaningful when integration exists. Engel-Granger integration test was performed for each money demand. Table 4 shows that no integration is rejected for broad money demand and foreign currency deposit. Therefore, error correction terms for broad money and foreign currency deposit are two good candidates for short-run inflation estimate.

Table 4: Engel-Granger cointegration test of money demand equations.

Money (M)	Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
currency in circulation	*LOG(M)-LOG(P)*	-3.190	0.332	215.061	1.000
narrow money	*LOG(M)-LOG(P)*	-3.514	0.201	78.909	1.000
broad money	*LOG(M)-LOG(P)*	-2.407	0.721	-31.182	0.0387**
foreign currency deposit	*LOG(M)-LOG(P)*	-2.401	0.724	-30.794	0.0418**

The following Table 5 illustrates the result of our analysis about inflation by combing the short-run factors and long-run factor of inflation. The main result is that the change in money supply seems not to significantly affect inflation; but the change in mark-up factors seems to have significant impacts on inflation. The dependent variable is the current inflation and four types of money are used.

When we use currency as money, as shown in column 2 of the Table 5, the result shows that inflation in the previous period, change in rice price in the previous two period and money growth in the previous period are significantly determinants of current inflation. When price is moving above its long-run path, it will adjust to the long-run path as shown by the negative coefficient of EC1. The speed of adjustment to long run equilibrium price is 0.014 although it is not significant. The total effect of money growth, which is the sum of the coefficient of money growth in the previous periods, is 0.103. If other things equal, a one-percentage increase in currency will cause inflation to increase by 0.103 percentage point. Excess money supply, EC2, also cause inflation, but not significantly. Changes in gasoline price and minimum wage also contribute to inflation but not significantly. We obtain similar result when we use narrow money, which is currency plus demand deposit, as money. When we use liquidity as money, coefficient for excess money, EC2, becomes smaller than when narrow money is used. Similar result is

obtained when we use foreign currency as money. Excess money plays less important role in explaining inflation when foreign currency or liquidity is used as money than when currency or narrow money is used as money. Because the dominant part of liquidity is foreign currency, excess foreign money has less impact on inflation than excess local currency. However, the total effect of money growth on inflation is greater when we use liquidity as money than when we use currency as money.

Table 5: Determinants of short-run inflation.

Dependent variable: DLOG(CPI_ALL)

Independent variables	Money			
	Currency	Narrow money	liquidity	FCD
C	0.001	0.001	0.000	0.000
ΔLOG(CPI_ALL(-1))	0.220 *	0.217 *	0.187	0.205 *
ΔLOG(CPI_ALL(-2))	0.085	0.078	0.066	0.037
ΔLOG(GASOLINE(-1))	0.014	0.015	0.008	0.011
ΔLOG(GASOLINE(-2))	0.023	0.023	0.014	0.015
ΔLOG(EX_RATE(-1))	-0.056	-0.085	-0.102	-0.103
ΔLOG(EX_RATE(-2))	0.058	0.065	0.029	0.011
ΔLOG(MIN_WAGE(-1))	0.043	0.031	0.028	0.023
ΔLOG(MIN_WAGE(-2))	-0.096	-0.085	-0.054	-0.036
ΔLOG(RICE(-1))	0.242 ***	0.243 ***	0.240 ***	0.244 ***
ΔLOG(RICE(-2))	-0.104 ***	-0.101 ***	-0.067 *	-0.065 *
EC1(-1)	-0.014	-0.013	-0.026	-0.021
EC2(-1)	0.004	0.005	0.003	0.003
ΔLOG(Money)(-1)	0.041 *	0.025	0.096 ***	0.077 ***
ΔLOG(Money)(-2)	0.028	0.037	0.071 **	0.058 **
ΔLOG(Money)(-3)	0.024	0.019	-0.008	-0.024
ΔLOG(Money)(-4)	-0.012	-0.002	0.007	0.022
ΔLOG(Money)(-5)	0.020	0.010	-0.050	-0.053 *
ΔLOG(Money)(-6)	0.018	0.017	0.025	0.030
ΔLOG(Money)(-7)	-0.015	-0.018	-0.026	-0.020
total effect of money	0.103	0.088	0.114	0.092
R-squared	0.751	0.746	0.768	0.769
Adjusted R-squared	0.706	0.700	0.726	0.727
S.E. of regression	0.006	0.006	0.006	0.006
Sum squared resid	0.004	0.004	0.004	0.004
Log likelihood	468.297	467.089	472.745	472.887
F-statistic	16.663	16.239	18.300	18.354
Prob(F-statistic)	0.000	0.000	0.000	0.000
N.of observations	125	125	125	125

In comparison with other studies, the coefficient for the markup error correction term (EC1) is relatively small. But the coefficient for the excess money error correction term (EC2) is similar. Brouwer and Erisson (1998) used mark-up theory to estimate inflation in Australia. They find that the markup coefficient for estimating inflation in Australia is -0.089, which is much larger in absolute value than the estimate result in this paper. The markup has a negative effect, as required for dynamic stability of the equation. However, Brouwer and Erisson did not include monetary theories in their estimate of inflation.

Oomes and Ohnsorge (2005) combine both mark-up theory and monetary theory to estimate inflation in dollarized Russian economy. They show that an excess supply of effective broad money is inflationary, while other excess money measures are not. The coefficient for the markup error correction term, captures the short-run correction of inflation to temporary deviations from the long-run equilibrium in the goods market in which prices are determined, ranges from -0.08 to -0.16, which is much larger than my estimate for Cambodia in absolute value . They find the estimated coefficient for excess money to be 3.7, suggesting that an excess supply of money of 1% translates into a 3.7% acceleration in inflation. Besides broad money, excess money has no significant effect on inflation. Goujon (2006) estimate inflation in Vietnam and find that the coefficient for excess money was weak, which is equal to 0.03 indicating that a one-percentage point reduction in EC2 induces a decrease in the inflation rate of 0.03 percentage points. The results indicate that inflation is explained by exchange rate changes and by excess money.

5 Conclusions

Money supply in a highly dollarized Cambodian economy appears to be highly unstable because the composition of domestic currency in aggregate money supply is very small. During its transition towards a market economy, Cambodia embarked upon a path of disinflation through dollarization and stable exchange rate. In this paper, the trend and behavior of money supply, money demand and inflation are examined, and a model is developed to explain the determinants of inflation under dollarization and estimate it for Cambodia in the 2000s using a two-step procedure. This paper shows that management of rice price, gasoline price with a restrictive monetary policy based on broadly defined money or total liquidity was essential for the Cambodian authorities to succeed in fighting inflation. This paper explains the behavior of inflation and the role that a central bank may play in its determination.

6 Acknowledgments

I would like to first express my deep gratitude to Professor Fukuda Shin-Ichi, Professor Ueda Ken-ichi, for guidance on the research, helpful comments and critical feedbacks on my work.

References

[1] Bordo, Michael D., and Ehsan U. Choudhri. ”Currency substitution and the demand for money: Some evidence for Canada.” Journal of Money, Credit and Banking 14, no. 1 (1982): 48-57.

[2] Brouwer, G.D. and Ericsson, N.R., 1998. Modeling inflation in Australia. Journal of Business and Economic Statistics, 16(4), pp.433-449.

[3] Duesenberry, J., 1950. The mechanics of inflation. The Review of Economics and Statistics, pp.144-149.

[4] Franz W, Gordon RJ. German and American wage and price dynamics: differences and common themes. European Economic Review. 1993 May 1;37(4):719-54.

[5] Friedman, M. and Schwartz, A.J., 1963. A Monetary history of the US 1867-1960. Princeton University Press.

[6] Oomes, N. and Ohnsorge, F., 2005. Money demand and inflation in dollarized economies: The case of Russia. Journal of Comparative Economics, 33(3), pp.462-483.